



Contents

Preface	1
Plenary Papers	
The role of biaxial stresses in discriminating between meaningful and illusory composite failure theories L. J. HART-SMITH (USA)	3
An evaluation of equivalent-single-layer and layerwise theories of composite laminates J. N. REDDY (USA)	21
Session 1— Energy absorbing structures	
The influence of trigger configurations and laminate lay-up on the failure mode of composite crush cylinders H. G. S. J. THUIS & V. H. METZ (Netherlands)	37
Session 2 — Brittle matrix structures	
Comparison between the short and long term behaviour of fibre reinforced and unreinforced concrete beams J. A. PURKISS (UK) & P. BLAGOJEVIĆ (Yugoslavia)	45
Examples of the multicriteria optimization of cement-based composites A. M. BRANDT & M. MARKS (Poland)	51
Session 3 — Damage tolerance A	
A simplified tensile damage analysis method for composite laminates using a quasi-three-dimensional model T. NISHIWAKI, A. YOKOYAMA, Z. MAEKAWA, H. HAMADA, Y. MAEKAWA & S. MORI (Japan)	61
A reduced basis approach to quantifying damage dependent dynamic response of laminated composite structures J. J. ENGBLOM & Q. YANG (USA)	69
Session 4 — Vibrations	
Free vibration of generally-laminated, shear-deformable, composite rectangular plates using a spline Rayleigh-Ritz method D. J. DAWE & S. WANG (UK)	77
Flutter analysis of cantilevered curved composite panels R. M. V. PIDAPARTI (USA)	89
Session 5 — Environmental effects	
Weight change mechanism of randomly oriented GFRP panel immersed in hot water T. MORII, H. HAMADA, Z. MAEKAWA, T. TANIMOTO, T. HIRANO & K. KIYOSUMI (Japan)	95
The effects of environmental humidity after post cure on the optimal temperature path of polymer composites R. S. CHEN, G. S. CHEN & J. R. CHEN (Taiwan)	101

Session 6 — Damage tolerance B

- Artificial damage techniques for low velocity impact in carbon fibre composites 113
M. P. CLARKE & M. J. PAVIER (UK)
- Impact damage evaluation on advanced stitched composites by means of acoustic emission
and image analysis 121
C. CANEVA, S. OLIVIERI, C. SANTULLI & G. BONIFAZI (Italy)

Session 7 — Localised effects

- Numerical investigations of free edge effects in integrally stiffened layered composite
panels. 129
I. SKRNA-JAKL & F. G. RAMMERSTORFER (Austria)
- On closed form solution for the elastic stress field around holes in orthotropic composite
plates under in-plane stress conditions 139
N. BONORA, M. COSTANZI & M. MARCHETTI (Italy)

Session 8 — Shell structures A

- Stresses in rotating composite cylindrical shells 157
J. T.-S. WANG & C.-C. LIN (Taiwan)
- A unified formulation of laminated composite, shear deformable, five-degrees-of-freedom
cylindrical shell theories 165
K. P. SOLDATOS & T. TIMARCI (UK)
- Nonlinear analysis of laminated composite plates and shells including the effects of shear
and normal deformation 173
V. E. VERIJENKO (South Africa)

Session 9 — Materials aspects B

- Calculation of effective moduli of fibrous composites with micro-mechanical damages . . . 187
Y. W. KWON (USA)
- Effect of motion parameters on the tribological behaviour of ptfе-based composite . . . 193
W. W. MARZOUK (Egypt)

Session 10 — Joints

- Designing for damage tolerant bonded joints 201
R. JONES, W. K. CHIU & J. PAUL (Australia)
- Stress and strength analysis of composite joints using direct boundary element method . . 209
C.-C. LIN & C.-H. LIN (Taiwan)
- Adhesive interface element for bonding of laminated plates. 217
C.-C. LIN & T.-C. KO (Taiwan)

Session 11 — Metal matrix composites

- Compressive and shear buckling analysis of metal matrix composite sandwich panels under
different thermal environments 227
W. L. KO & R. H. JACKSON (USA)
- Postbuckling analysis and imperfection sensitivity of metal matrix laminated cylindrical
panels. 241
E. FELDMAN & J. ABOUDI (Israel)

Session 12 — Impact studies

- Scaling of impact damage in fiber composites from laboratory specimens to structures . . . 249
S. R. SWANSON (USA)
- Delamination and matrix cracking of cross-ply laminates due to a spherical indenter . . . 257
S. LIU (USA)
- A parametric study of residual strength and stiffness for impact damaged composites . . . 267
V. L. CHEN, H.-Y. T. WU & H.-Y. YEH (USA)

Session 13 — Materials aspects A

- Identification of material properties of composite plate specimens 277
C. M. MOTA SOARES, M. MOREIRA DE FREITAS, A. L. ARAÚJO (Portugal) &
P. PEDERSEN (Denmark)
- Effect of the free edge finishing on the tensile strength of carbon/epoxy laminates . . . 287
S. F. MÜLLER DE ALMEIDA & G. M. CÂNDIDO (Brazil)

Session 14 — Shell structures B

- Limit load carrying capacity for spherical laminated shells under external pressure . . . 295
A. MUC, J. RYŚ & W. ŁATAS (Poland)
- Optimisation of laminated cylindrical pressure vessels under strength criterion 305
S. ADALI, E. B. SUMMERS & V. E. VERIJENKO (South Africa)

Session 15 — Design and development

- Development of the anthropomorphic robot with carbon fiber epoxy composite materials . . 313
D. G. LEE, K. S. JEONG, K. S. KIM & Y. K. KWAK (Korea)

Session 16 — Failure analysis

- A two-dimensional analysis of multiple matrix cracking in a laminated composite close to
its characteristic damage state 325
D. GAMBY & J. L. REBIÈRE (France)
- Thermal and mechanical fatigue analysis of CFRP laminates 339
C. M. L. WU (Hong Kong)

Session 17 — Buckling studies

- Thermal buckling of bimodular sandwich beams 345
T. LAN, P. D. LIN & L. W. CHEN (Taiwan)
- Buckling and vibration of thin laminated composite, prismatic shell structures 353
S. MOHD (Malaysia) & D. J. DAWE (UK)
- Influence of the prebuckling stress-field on the critical loads of inhomogeneous composite
laminates 363
M. D. PANDEY & A. N. SHERBOURNE (Canada)

Session 18 — Smart structures

- Dynamic behavior of cross-ply laminated beams with piezoelectric layers 371
H. ABRAMOVICH & A. LIVSHITS (Israel)
- Smart structures — vibration of composites with piezoelectric materials 381
S. M. YANG & J. W. CHIU (Taiwan)

Session 19 – Composite beams A

- Short- and long-term structural properties of pultruded beam assemblies fabricated using adhesive bonding 387
J. T. MOTTRAM (UK)

Session 20 – Finite element analysis A

- Analysis of sandwich plates using a mixed finite element 397
C.-P. WU & C.-C. LIN (Taiwan)
- Assessment of interlaminar stress distribution in CFRP laminates containing transverse crack using finite element model 407
A. YOKOYAMA, Z. MAEKAWA, H. HAMADA & T. OKUMURA (Japan)

Session 21 – Laminate theory

- Analysis of stiffness loss in cross-ply composite laminates 419
T. E. TAY & E. H. LIM (Singapore)
- High strain rate compressional behavior of stitched and unstitched composite laminates with radial constraint 427
S. T. JENQ & S. L. SHEU (Taiwan)
- A new local high-order laminate theory 439
C.-P. WU & C.-S. HSU (Taiwan)
- Dispersive waves in composites, a comparison between various laminated plate theories . . 449
W. J. N. LIMA & A. M. B. BRAGA (Brazil)

Session 22 – Stiffened structures

- Optimum design for buckling of plain and stiffened composite axisymmetric shell panels/shells 459
B. TRIPATHY & K. P. RAO (India)
- Buckling of open-section bead-stiffened composite panels 469
D. H. LAANANEN & S. P. RENZE (USA)
- Vibration of composite-material cylindrical shells with ring and/or stringer stiffeners . . 477
C. W. BERT, C.-D. KIM & V. BIRMAN (USA)
- The buckling of composite stiffened plates with some emphasis on the effects of fibre orientation and on loading configuration 485
J. LOUGHLAN & J.-M. DELAUNOY (UK)

Session 23 – Platework structures

- An evaluation of the edge solution for a higher-order laminated plate theory 495
M. KARAMA, M. TOURATIER & A. IDLBI (France)
- Reliability analysis of nonlinear laminated composite plate structures 503
T. Y. KAM, S. C. LIN & K. M. HSIAO (Taiwan)
- Analysis of local bending effects in sandwich plates with orthotropic face layers subjected to localised loads. 511
O. T. THOMSEN (Denmark)
- Eigen analysis of fiber-reinforced composite plates 521
A. M. ABD-EL-RAOUF, E. E. EL-SOALY, S. M. GHONEAM &
A. A. HAMADA (Egypt)
- Large deflection initial failure analysis of angle-ply laminated plates 529
G. J. TURVEY (UK) & M. Y. OSMAN (Sudan)

Session 24 — Finite element analysis B

- Static stress analysis of composite spur gears using 3D-finite element and cyclic symmetric approach 541
 S. M. NABI & N. GANESAN (India)
- A damage mechanics tool for laminate delamination 547
 L. DAUDEVILLE & P. LADEVÈZE (France)

Session 25 — Aircraft structures

- Carbon composite repairs of helicopter metallic primary structures 557
 M. L. OVERD (UK)
- On design methods for bolted joints in composite aircraft structures 567
 T. IREMAN, T. NYMAN & K. HELLBOM (Sweden)

Session 26 — Composite beams B

- Mechanical bending behaviour of composite T-beams. 579
 A. SILVA, J. TRAVASSOS, M. M. DE FREITAS & C. M. MOTA SOARES
 (Portugal)
- Torsional response of inhomogeneous and multilayered composite beams 587
 M. SAVOIA & N. TULLINI (Italy)
- Author Index 595
- Subject Index 596